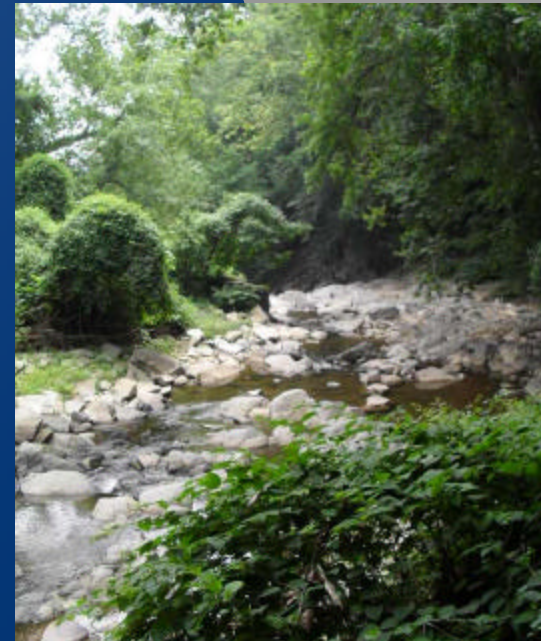
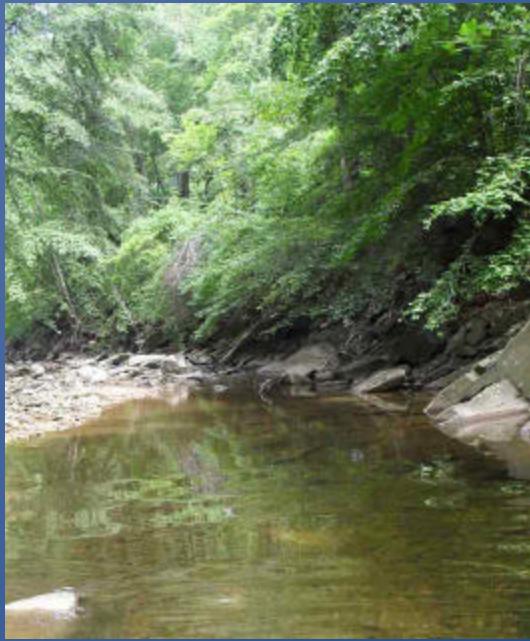


# Bacteria Total Maximum Daily Load Studies for Sugarland Run, Mine Run, and Pimmit Run

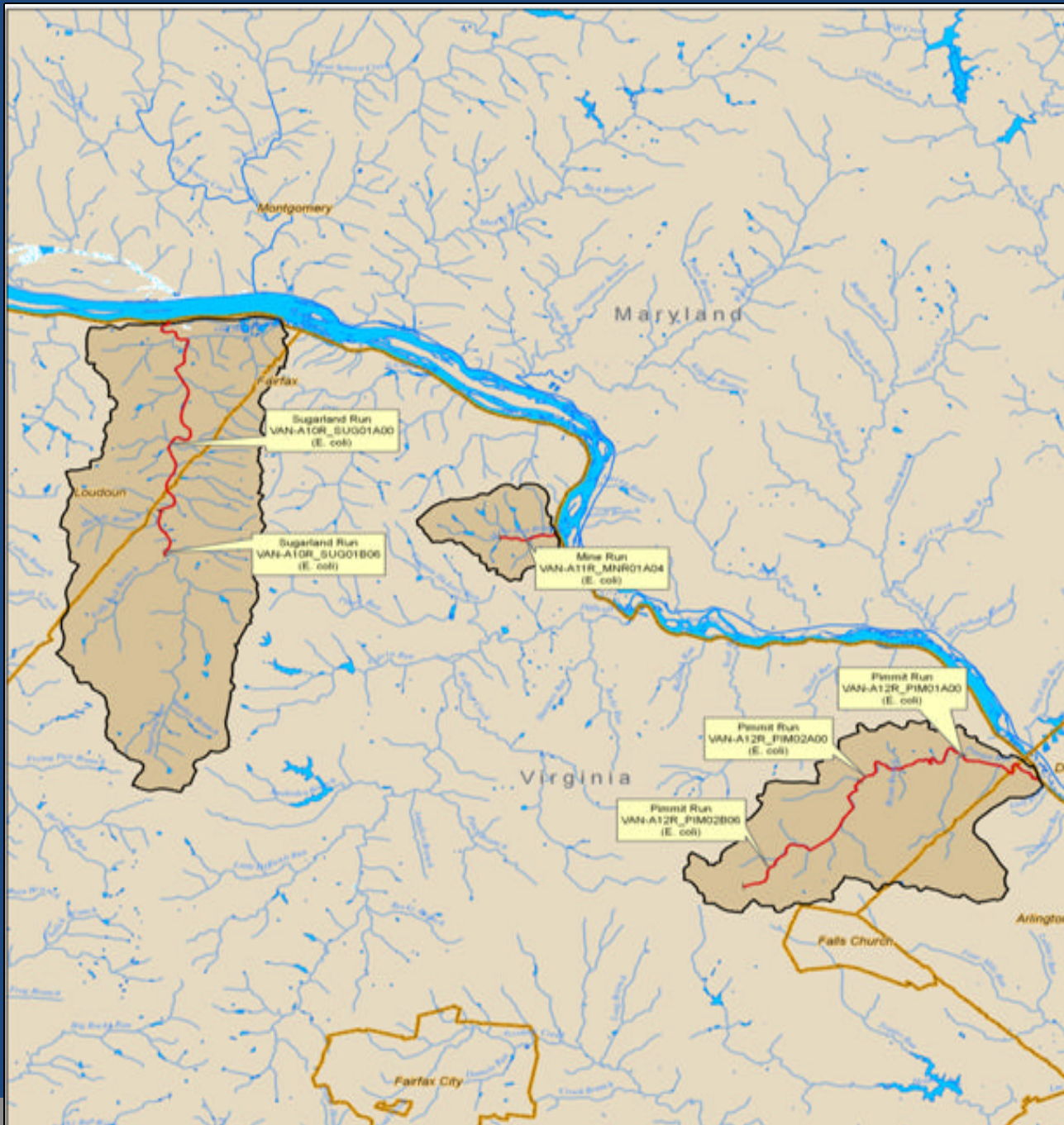


Technical Advisory Committee Meeting #3  
November 16, 2011

# Meeting Agenda

- ◉ **Project Updates** (*DEQ*)
- ◉ **Technical Approach** (*Louis Berger Group*)
  - Hydrologic and Water Quality Model Calibration and Validation
  - TMDL Annual Bacteria Loadings for Sugarland Run, Mine Run, and Pimmit Run
  - Draft TMDL Allocations
- ◉ **Next Steps** (*DEQ*)
- ◉ **Questions**





### 3 listed Segments:

- Sugarland Run
- Mine Run
- Pimmit Run

#### Legend

- 303(d) Impaired Stream/River
- ▭ Watershed Boundaries
- ▭ County
- Waterbody
- ▨ Swamp/Marsh
- Stream/River

Waterbody Name <i>Location</i>	Segment Size	Cause	Upstream Limit	Downstream Limit	DEQ Monitoring Station(s) <i>Station Location</i>	Year First Listed as Impaired	2010 Exceedance Rate
<b>Sugarland Run</b> <i>Fairfax County Loudoun County Town of Herndon</i>	0.95 miles	<i>E. coli</i>	Confluence with Folly Lick Branch	Boundary of the PWS designation area, at rivermile 4.82	<b>1aSUG004.42</b> <i>Route 7 Bridge Crossing</i>	2006	5 of 28 samples (17.9%)
	4.77 miles	<i>E. coli</i>	Boundary of the PWS designation area, at rivermile 4.82	Confluence with the Potomac River	<b>1aSUG004.42</b> <i>Route 7 Bridge Crossing</i>	2002	5 of 28 samples (17.9%)
<b>Mine Run</b> <i>Fairfax County</i>	0.93 miles	<i>E. coli</i>	Confluence with an unnamed tributary to Mine Run	Confluence with the Potomac River	<b>1aMNR000.72</b> <i>Route 603 Bridge Crossing</i>	2006	3 of 12 samples (25.0%)
<b>Pimmit Run</b> <i>Arlington County Fairfax County</i>	1.62 miles	<i>E. coli</i>	Confluence with Little Pimmit Run	Confluence with the Potomac River	<b>1aPIM000.15</b> <i>Route 120 (Glebe Road) Bridge Crossing</i>	2010*	3 of 11 samples (27.3%)
	2.46 miles	<i>E. coli</i>	Route 309 bridge crossing	Confluence with Little Pimmit Run	<b>1aPIM001.89</b> <i>Ranleigh Road Bridge Crossing</i>	2010*	3 of 14 samples (21.4%)
	3.29 miles	<i>E. coli</i>	Headwaters of Pimmit Run	Route 309 bridge crossing	<b>1aPIM004.16</b> <i>Route 309 Bridge Crossing</i>	2010*	4 of 10 samples (40.0%)

\* Pimmit Run was originally listed with a fecal coliform bacteria impairment from 2002 to 2008. 2010 was the first assessment cycle where Pimmit Run was listed as impaired for *E. coli*.

# Follow-Up From TAC Meeting #2

## ⦿ Updated Source Assessment

- Horse population numbers
- Corrected population/household numbers in Source Assessment tables
- Clarified sources/references in report
- Updated how straight pipes were represented in the model.

***OLD Method: Loadings were estimated using a county specific failure rate (Fairfax and Arlington 3%; Loudoun County 2%) for septic systems and assuming all Houses on "Other Means" were straight pipes.***

Impaired Watershed	Houses on Septic Systems	Failing Septic Systems	Houses on "Other Means" <i>Originally Assumed to be Straight Pipes</i>
Sugarland Run	1,507	45†	48
Mine Run	24	1	1
Pimmit Run	872	26‡	38

†For portion of Sugarland Run in Loudoun County, a 2% septic failure rate was provided. Everywhere else a 3% failure rate was used.

‡This number incorporates Arlington County's estimate of 8 septic systems for the portion of Pimmit Run within Arlington County

***NEW Method: Loadings were estimated using a county specific failure rate (Fairfax and Arlington 3%; Loudoun County 2%) for septic systems and for houses on "Other Means."***

Impaired Watershed	Houses on Septic Systems	Failing Septic Systems	Houses on "Other Means" <i>Originally Assumed to be Straight Pipes</i>	<i>Estimated Number of Houses with a Failing Sewage Disposal System (Failing Septic Systems and Straight Pipes)</i>
Sugarland Run	1,507	45†	48	46†
Mine Run	24	1	1	1
Pimmit Run	872	26‡	38	27‡

†For portion of Sugarland Run in Loudoun County, a 2% septic failure rate was provided. Everywhere else a 3% failure rate was used.

‡This number incorporates Arlington County's estimate of 8 septic systems for the portion of Pimmit Run within Arlington County

# HSPF Model

# HSPF Model

## Linking Sources to Water Quality

Input



Model



Output

**Factors:**

Rainfall events

Fecal coliform build up

Fecal coliform direct  
deposition

Fecal coliform wash off

Fecal coliform die off rates



Watershed  
Boundary

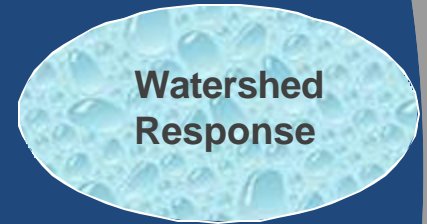
Land use

Soil

Stream

Pollutant Sources

Watershed  
Response



# Technical Approach: Source Loading Estimates

- ⦿ Determine the daily fecal coliform production by source
- ⦿ Estimate the size/number of each source
- ⦿ Determine whether the source is:
  - Direct Source
  - Indirect Source
- ⦿ Calculate the load to each land use based on a monthly schedule and for each source
- ⦿ The sum of all individual sources is the total load

# Water Quality Simulations

## FECAL INDICATOR TOOL

- Estimate source loadings of Fecal Coliform.
- Generate input data for Water Quality HSPF



## HSPF Model

Generates output of fecal coliform time series



## TRANSLATION

HSPF Time series of Fecal Coliform concentrations to  
*E. coli* concentrations



## CALIBRATION

Comparison of simulated *E. coli* loads to observed data

# HSPF Model Setup

- Hydrologic Modeling Area delineated to 38 model segments for bacteria loadings
  - Hydrologic Model Calibration/Validation
    - ? USGS Flow Station 01646000 (Difficult Run)
      - Calibration period: 2002- 2006
      - Validation period: 2007-2010
- Water Quality Model Calibration/Validation
  - ? Using DEQ water quality stations on impaired segment
  - ? Calibration period: 2002 - 2010
- Weather data:
  - ? NCDC hourly data from Reagan National Airport
- TMDL Period: 2002 - 2009

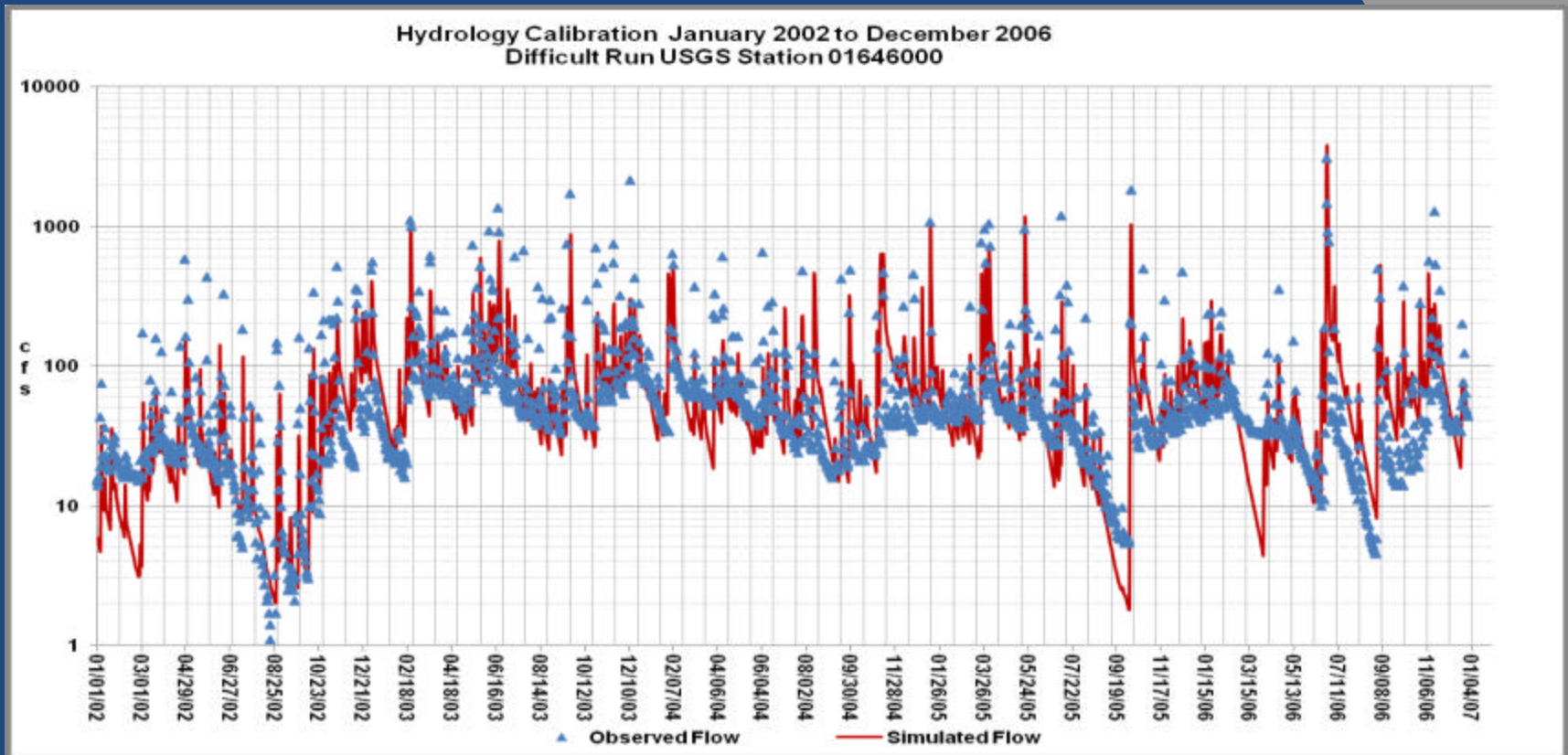


## Legend

- VADEQ Water Quality Station
- ▲ USGS Flow Station
- 303(d) Impaired Segment
- Modeling Segments
- Watershed Boundary
- State
- Waterbody
- Stream

# Flow and Water Quality Calibration Stations

# HSPF Hydrological Calibration

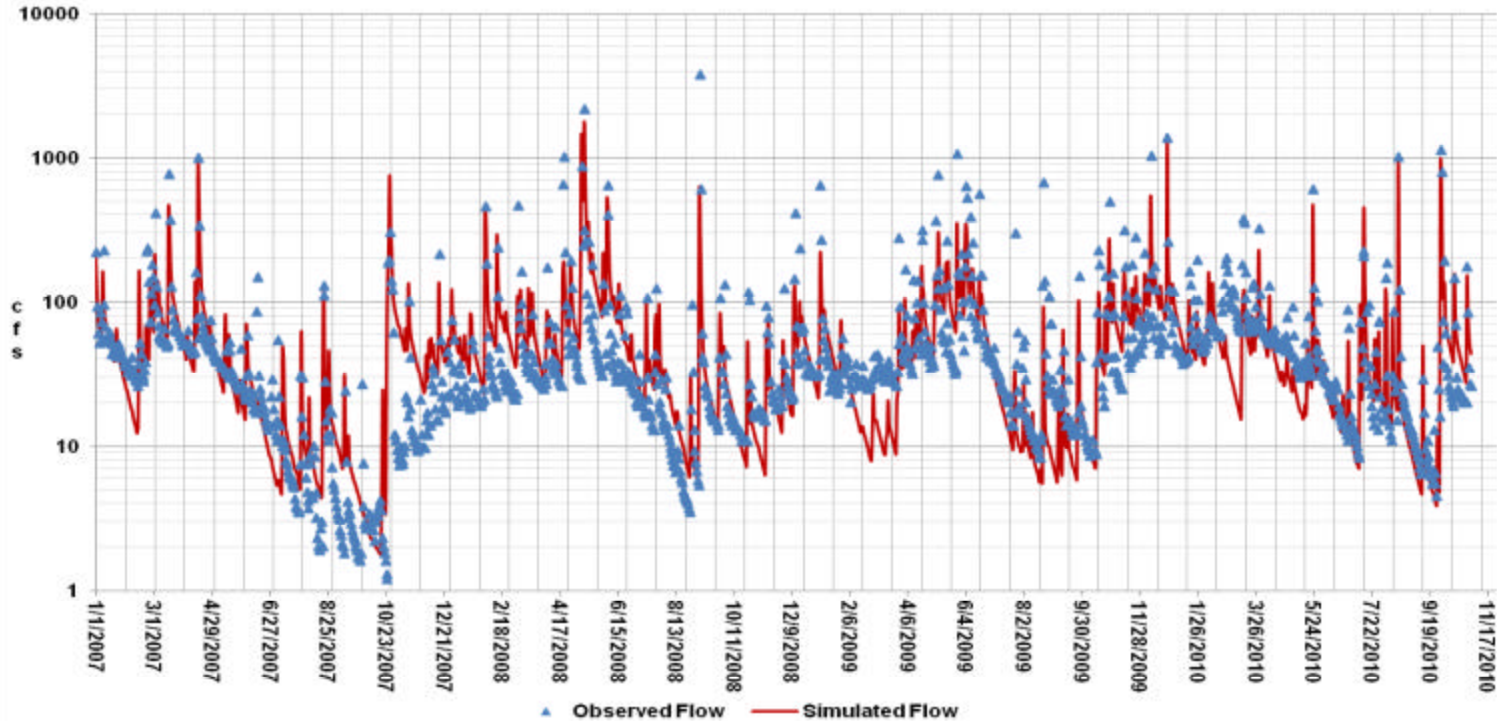


Category	Simulated	Observed
Total runoff, in inches	103.9	95.7
Total of highest 10% flows, in inches	47.72	47.27
Total of lowest 50% flows, in inches	14.57	15.04
Total storm volume, in inches	5.070	4.112
Baseflow recession rate	0.940	0.950
Summer flow volume, in inches	27.450	23.596
Winter flow volume, in inches	27.530	23.242
Summer storm volume, in inches	0.550	0.441

Category	Current	Criterion
Error in total volume	8.6	+ 10.000
Error in low flow recession	0.010	± 0.010
Error in 50% lowest flows	-3.100	± 10.000
Error in 10% highest Flow	1.000	± 15.000
Seasonal volume error	2.100	± 10.000

# HSPF Hydrological Validation

Hydrology Validation January 2007 to October 2010  
Difficult Run USGS Station 01646000



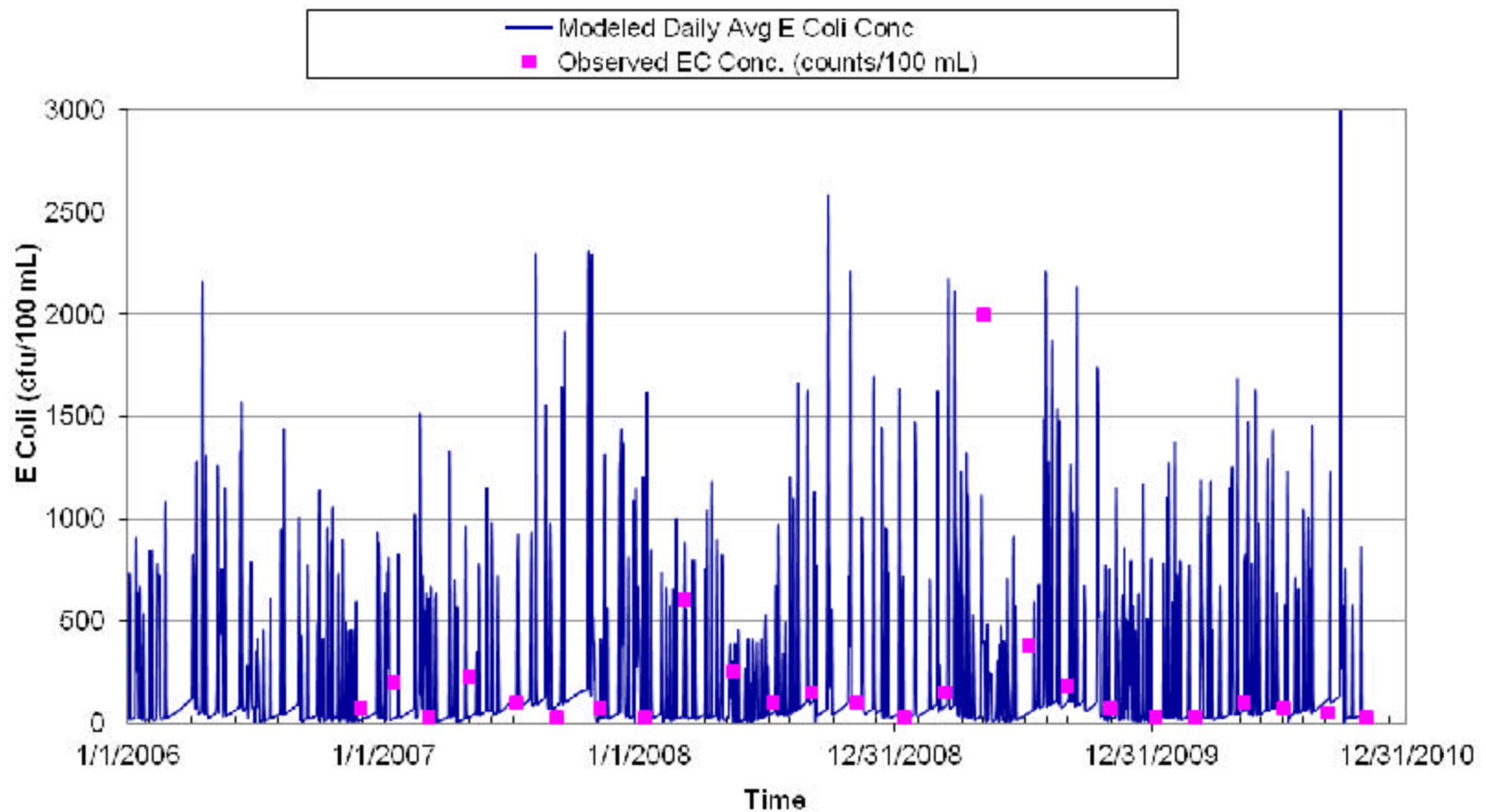
Category	Simulated	Observed
Total runoff, in inches	48.680	44.792
Total of highest 10% flows, in inches	22.920	24.343
Total of lowest 50% flows, in inches	5.410	5.900
Total storm volume, in inches	4.720	3.866
Baseflow recession rate	0.940	0.930
Summer flow volume, in inches	8.260	8.054
Winter flow volume, in inches	11.780	11.0007
Summer storm volume, in inches	4.690	4.021

Category	Current	Criterion
Error in total volume	8.700	$\pm 10.000$
Error in low flow recession	-0.010	$\pm 0.010$
Error in 50% lowest flows	-8.300	$\pm 10.000$
Error in 10% highest Flow	-5.800	$\pm 15.000$
Seasonal volume error	4.400	$\pm 10.000$

# Water Quality Calibration Stations

Location	WQ Station	Segment
Sugarland Run	1ASUG004.42	26
Mine Run	1AMNR000.72	15
Pimmit Run	1APIM004.16	76
Pimmit Run	1APIM000.15	40

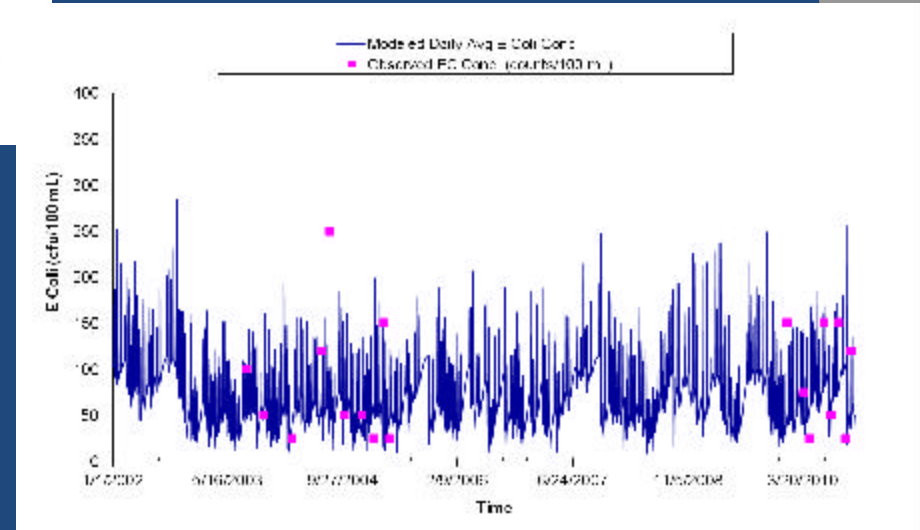
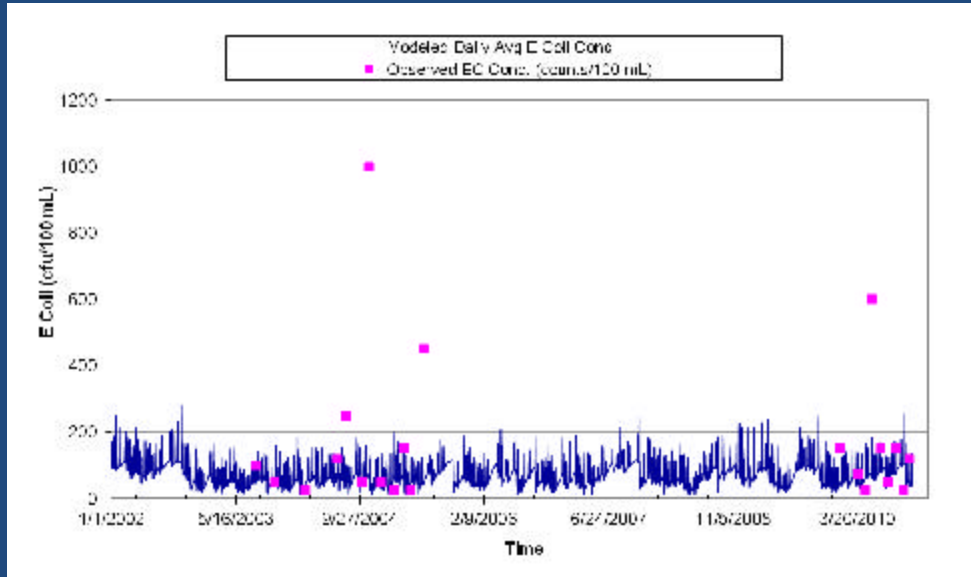
# WQ Calibration – Sugarland Run (1ASUG004.42)



E. coli Geometric Mean	
Simulated	Observed
79	96

% Exceedance E. coli Maximum Assessment Criterion	
Simulated	Observed
28	19

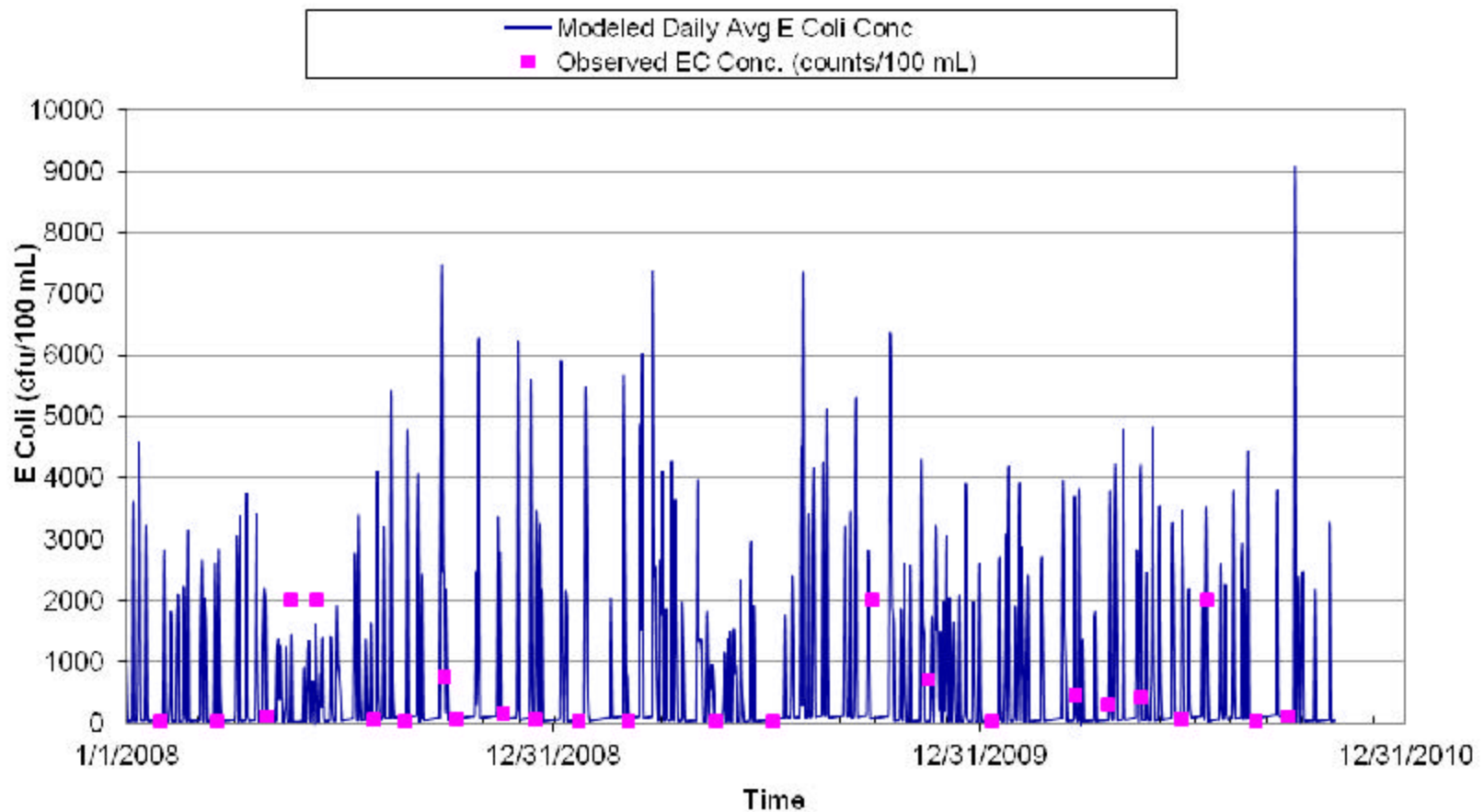
# WQ Calibration - Mine Run (1AMNR000.72)



E. coli Geometric Mean	
Simulated	Observed
62	93

% Exceedance E. coli Maximum Assessment Criterion	
Simulated	Observed
19	19

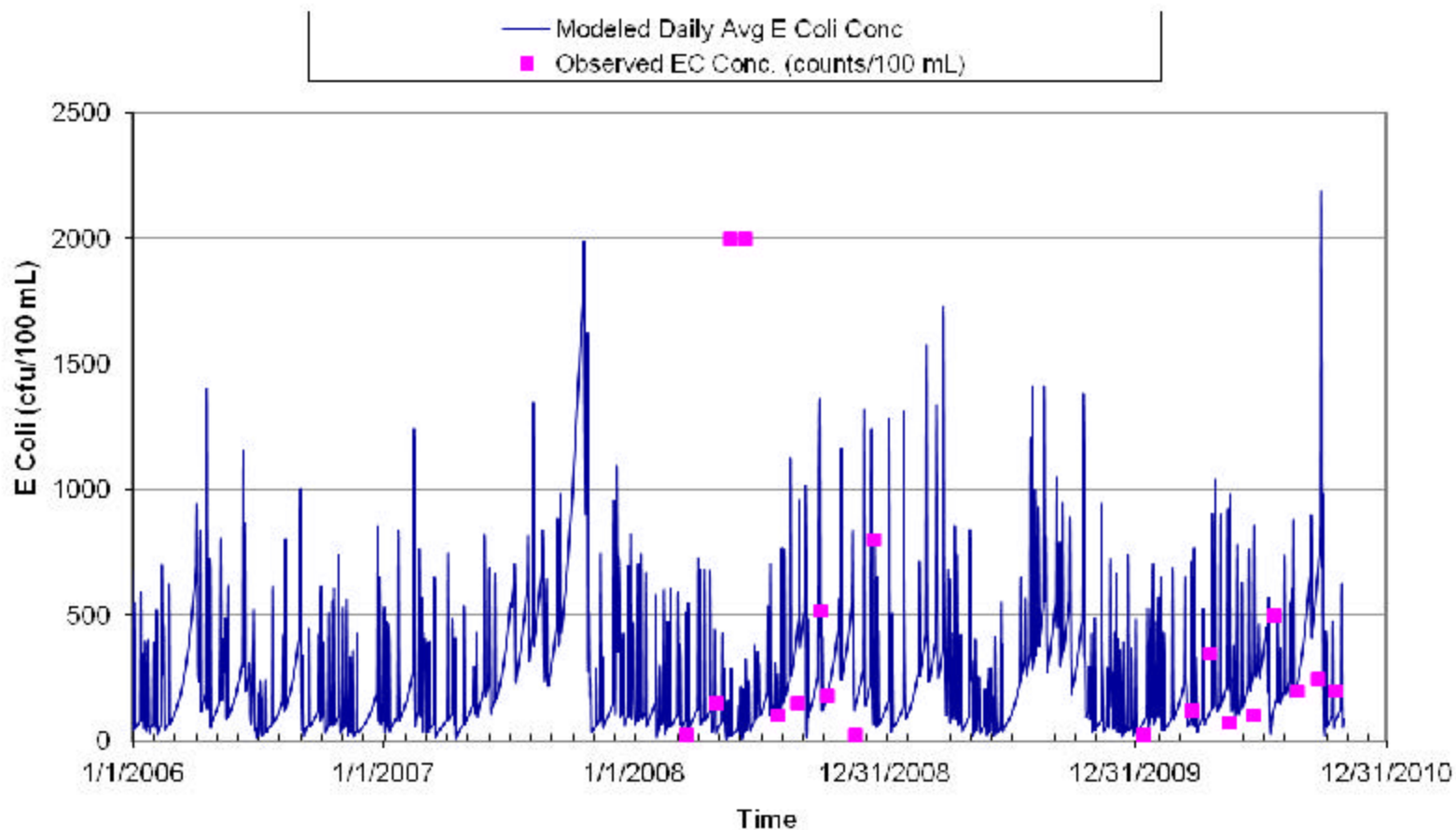
# WQ Calibration - Pimmit Run (1APIM000.15)



E. Coli Geometric Mean	
Simulated	Observed
108	127

% Exceedance E. coli Maximum Assessment Criterion	
Simulated	Observed
28	36

# WQ Calibration - Pimmit Run (1APIM004.16)



E. Coli Geometric Mean	
Simulated	Observed
166	188

% Exceedance E. coli Maximum Assessment Criterion	
Simulated	Observed
43	37

# MS4s

## Municipal Separate Storm Sewer System

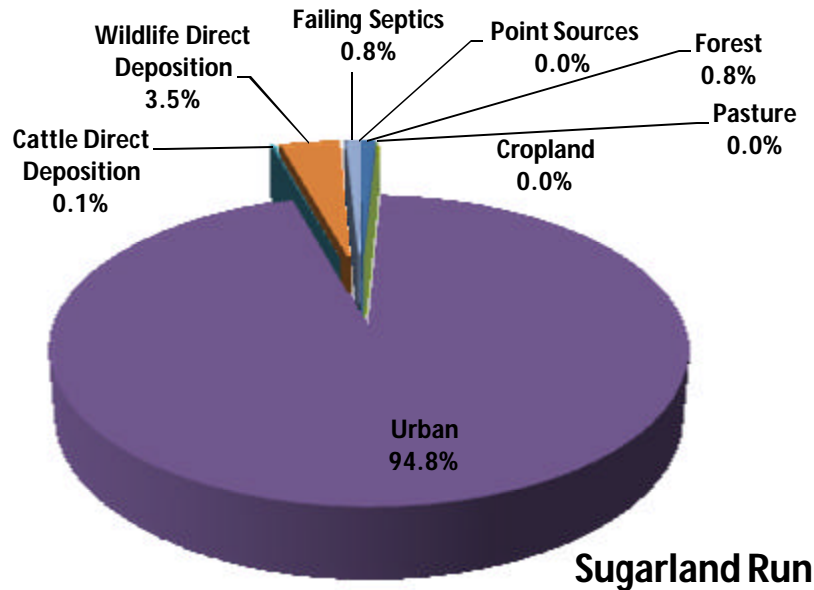
Permit Number	MS4 Permit	MS4 Geographical Area
Sugarland Run (A10R-01-BAC)		
VA0088587	Fairfax County	Fairfax County
VAR040104	Fairfax County Public Schools	
VAR040115	Virginia Department of Transportation	
VAR040067	Loudoun County	Loudoun County
VAR040115	Virginia Department of Transportation	
VAR040060	Town of Herndon	Town of Herndon
VAR040104	Fairfax County Public Schools	
VAR040115	Virginia Department of Transportation	
Pimmit Run (A12R-02-BAC)		
VA0088587	Fairfax County	Fairfax County
VAR040104	Fairfax County Public Schools	
VAR040111	George Washington Memorial Parkway	
VAR040115	Virginia Department of Transportation	Arlington County
VAR040067	Arlington County	
VAR040115	Virginia Department of Transportation	
VAR040111	George Washington Memorial Parkway	
Mine Run (A11R-02-BAC)		
VA0088587	Fairfax County	Fairfax County
VAR040104	Fairfax County Public Schools	
VAR040111	George Washington Memorial Parkway	
VAR040115	Virginia Department of Transportation	

# Point Source Inventory

(VA Department of Environmental Quality)

Permit Number	Residence	Watershed	Permit Type	Max Design Flow (MGD)	Permit Concentration (cfu/100 ml)
VAG406279	Residence	Sugarland Run	VPDES - General Domestic	0.001	126

# Existing Annual *E. coli* Loadings for Sugarland Run



## Types of Sources by Land Use:

Forest – Wildlife

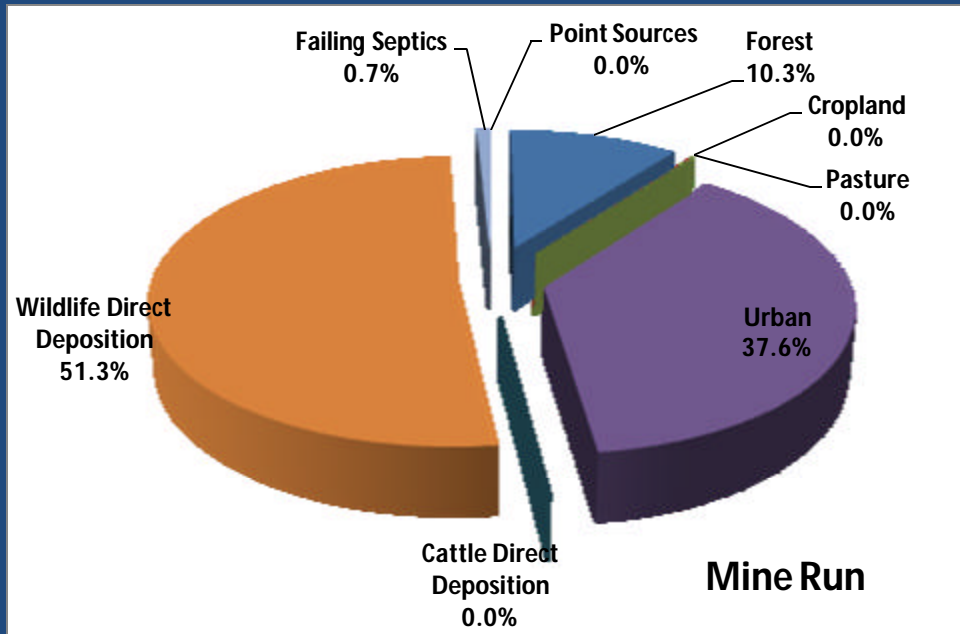
Cropland – Livestock and Wildlife

Pasture – Livestock and Wildlife

Urban – Pets and Wildlife

Source	Existing Annual Average <i>E. coli</i> Loads	
	cfu/yr	%
Forest	9.13E+11	0.8
Cropland	1.65E+09	<0.1
Pasture	2.97E+09	<0.1
Urban	1.08E+14	94.7
Cattle Direct Deposition	1.18E+11	0.1
Wildlife Direct Deposition	3.99E+12	3.5
Failing Septics	8.89E+11	0.8
Point Sources	1.74E+09	0.2
<b>Total</b>	<b>1.14E+14</b>	<b>100%</b>

# Existing Annual *E. coli* Loadings for Mine Run

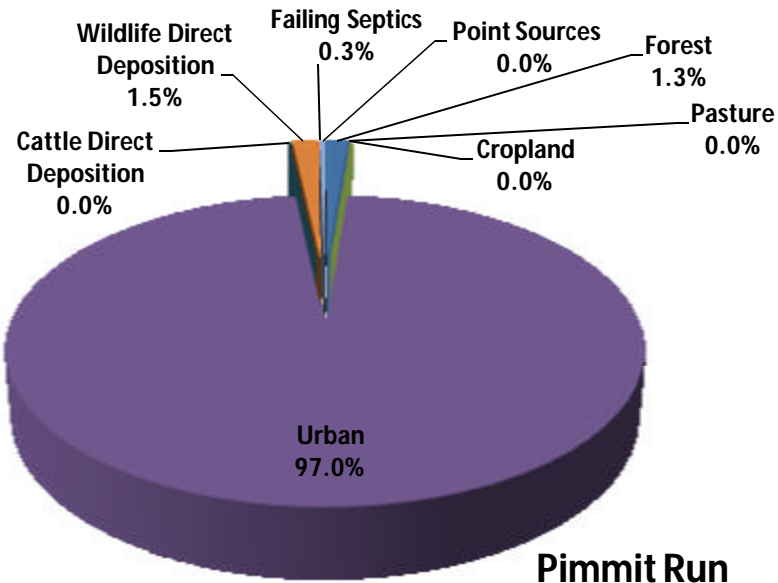


## Types of Sources by Land Use:

Forest – Wildlife  
 Cropland – Livestock and Wildlife  
 Pasture – Livestock and Wildlife  
 Urban – Pets and Wildlife

Source	Existing Annual Average <i>E. coli</i> Loads	
	cfu/yr	%
Forest	3.08E+11	10.3
Cropland	8.18E+08	<0.1
Pasture	6.74E+08	<0.1
Urban	1.12E+12	37.6
Cattle Direct Deposition	0.00E+00	0.0
Wildlife Direct Deposition	1.53E+12	51.3
Failing Septics	2.22E+10	0.7
Point Sources	0.00E+00	0.0
<b>Total</b>	<b>2.98E+12</b>	<b>100.0%</b>

# Existing Annual *E. coli* Loadings for Pimmit Run



## Types of Sources by Land Use:

Forest – Wildlife  
 Cropland – Livestock and Wildlife  
 Pasture – Livestock and Wildlife  
 Urban – Pets and Wildlife

Source	Existing Annual Average <i>E. coli</i> Loads	
	cfu/yr	%
Forest	2.70E+12	1.3
Cropland	8.09E+08	<0.1
Pasture	9.88E+08	<0.1
Urban	2.05E+14	97.0
Cattle Direct Deposition	0.00E+00	0.0
Wildlife Direct Deposition	3.10E+12	1.5
Failing Septics	5.30E+11	0.3
Point Sources	0.00E+00	0.0
Total	2.11E+14	100.0%

# TMDL Expression

$$\text{TMDL} = \sum \text{LA} + \sum \text{WLA} + \text{MOS}$$

LA = Load allocation (nonpoint source contribution)

WLA = Waste load allocation (point source contribution)

MOS = Margin of safety

# TMDL Allocation Strategy

- Human Sources
  - Failed Septic Systems
- Non Point Sources (NPS):
  - Direct Deposition
  - Indirect (Agriculture and Urban runoff)
- Wildlife Sources:
  - Direct and Indirect

# TMDL Allocation Objective

Zero exceedances of the *E. coli* Geometric Mean Criterion (126 cfu/100mL)

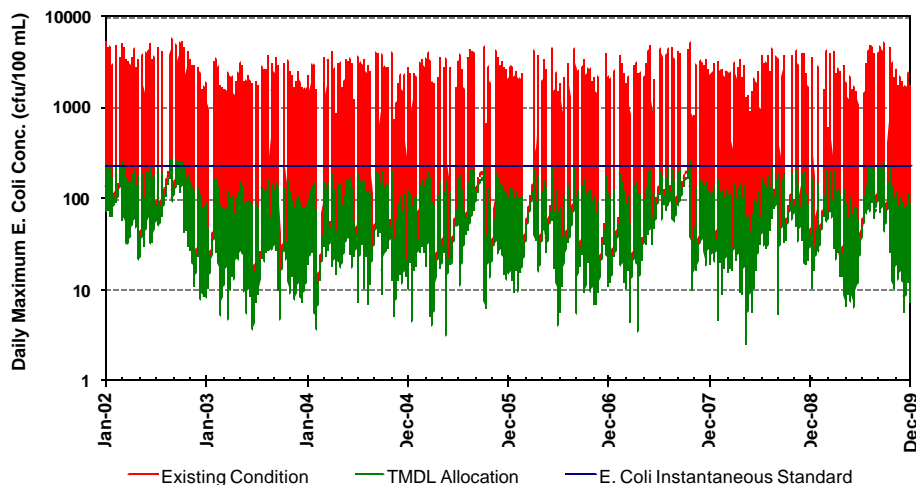
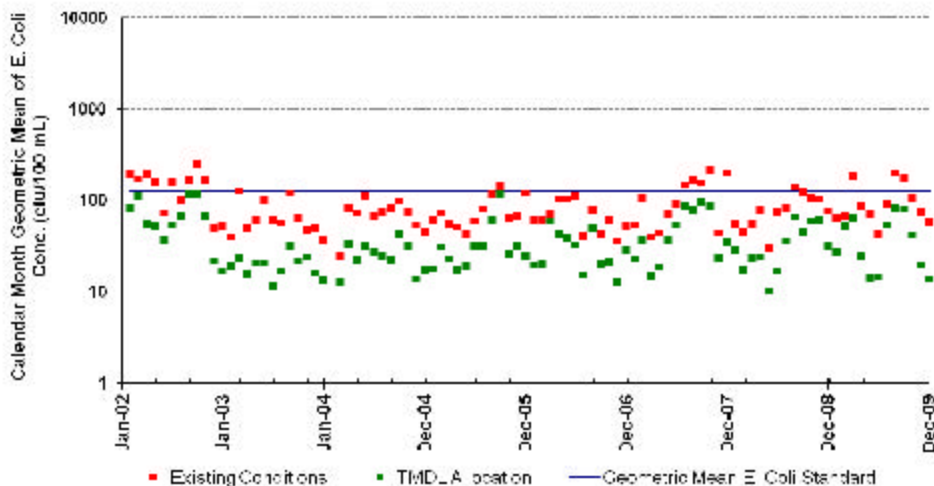
No more than 10% exceedance rate of the Maximum Assessment Criterion (235 cfu/100mL)

- Allocation Scenarios consist of an iterative process using HSPF simulation runs with varying percent reduction from each source.
- Allocation scenarios target anthropogenic sources first (failing septics, straight pipes, etc.).
- The objective is to identify a scenario that meets the Geometric Mean and the Maximum Assessment Criteria.

# Sugarland Run Scenarios

Scenario	Septics	Direct Cattle	NPS Agriculture	NPS Urban	Direct Wildlife	Percent Exceedance of <i>E. coli</i> Geometric Mean Criterion	Percent Exceedance of <i>E. coli</i> Maximum Assessment Criterion
0						21%	58%
1	100					18%	58%
2	100	50				18%	58%
3	100	100				18%	58%
4	100	100	100	100		0%	0%
5	100	100			50	3%	58%
6	100	100			75	0%	58%
7	100	100	95	95		1%	17%
8	100	100	80	80		3%	58%
9	100	100	85	85		2%	52%
10	100	100	90	90		1%	35%
11	100	50	50	50		10%	58%
12	100	75	75	75		4%	58%
13	100	100	96.6	96.6		0%	10%

# Draft Sugarland Run TMDL Allocation



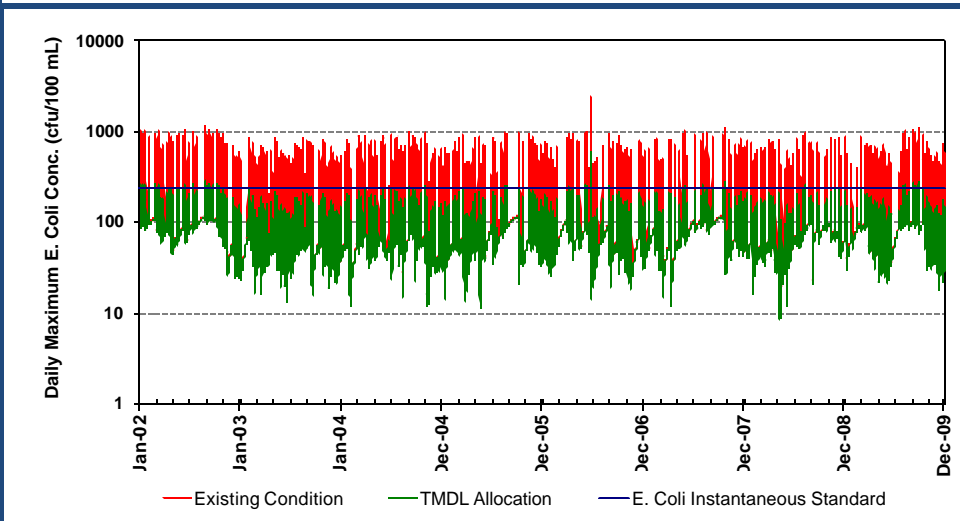
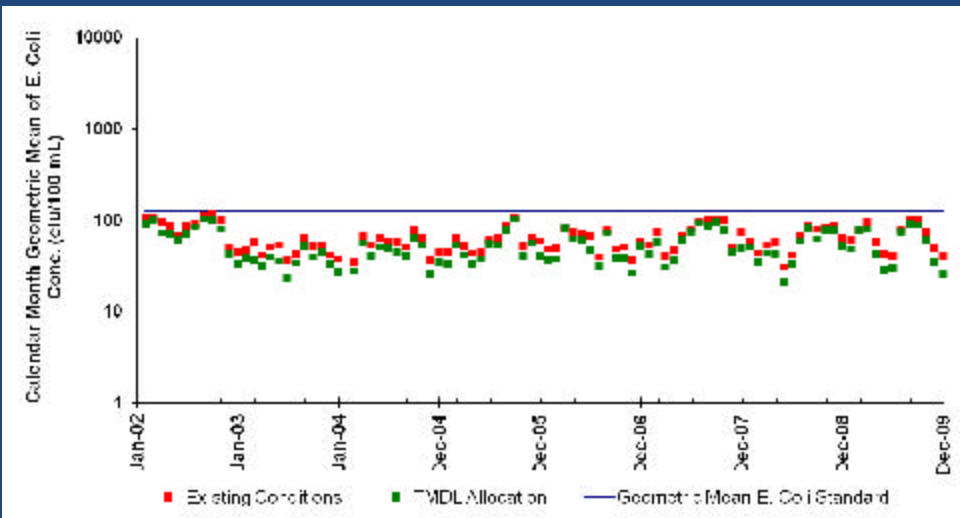
Landuse/Source	Annual Average E. coli Loads (cfu/yr)		Reduction (%)
	Existing	Allocation	
Forest	9.13E+11	9.13E+11	0.0
Cropland	1.65E+09	5.61E+07	96.6
Pasture	2.97E+09	1.01E+08	96.6
Urban	1.08E+14	3.67E+12	96.6
Cattle Direct Deposition	1.18E+11	0.00E+00	100.0
Wildlife Direct Deposition	3.99E+12	3.99E+12	0.0
Failing Septics	8.89E+11	0.00E+00	100.0
VPDES Point Sources*	1.74E+09	8.75E+10*	0.0

\*Draft allocation for VPDES Point Sources includes an allowance for the future growth and expansion of point sources in the watershed.

# Mine Run Scenarios

Scenario	Septics	Direct Cattle	NPS Agriculture	NPS Urban	Direct Wildlife	Percent Exceedance of <i>E. coli</i> Geometric Mean Criterion	Percent Exceedance of <i>E. coli</i> Maximum Assessment Criterion
0						0%	48%
1	100					0%	45%
2	100	50				0%	45%
3	100	100				0%	45%
4	100	100	100	100		0%	0%
5	100	100			50	0%	45%
6	100	100			75	0%	45%
7	100	100	95	95		0%	0%
8	100	100	78.5	78.5		0%	10%

# Draft Mine Run TMDL Allocation



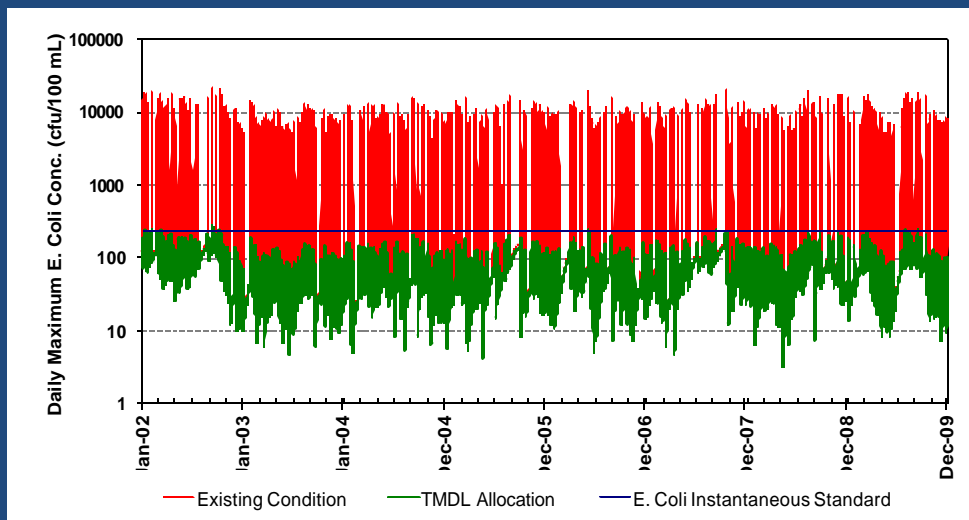
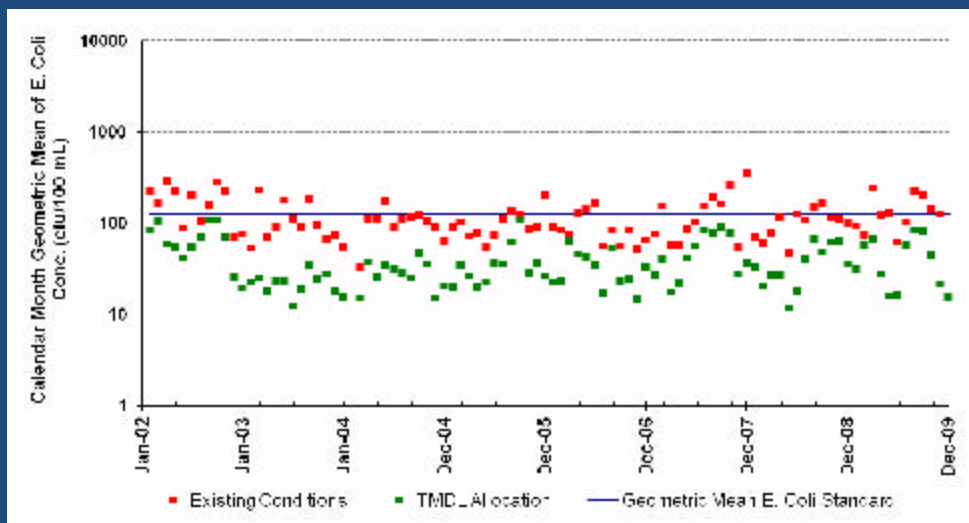
Landuse/Source	Annual Average E. coli Loads (cfu/yr)		Reduction (%)
	Existing	Allocation	
Forest	3.08E+11	3.08E+11	0.0
Cropland	8.18E+08	1.76E+08	78.5
Pasture	6.74E+08	1.45E+08	78.5
Urban	1.12E+12	2.41E+11	78.5
Cattle Direct Deposition	0.0	0.0	100.0
Wildlife Direct Deposition	1.53E+12	1.53E+12	0.0
Failing Septics	2.22E+10	0.00E+00	100.0
VPDES Point Sources*	0.0	2.08E+10*	0.0

\*Draft allocation for VPDES Point Sources includes an allowance for the future growth and expansion of point sources in the watershed.

# Pimmit Run Scenarios

Scenario	Septics	Direct Cattle	NPS Agriculture	NPS Urban	Direct Wildlife	Percent Exceedance of <i>E. coli</i> Geometric Mean Criterion	Percent Exceedance of <i>E. coli</i> Maximum Assessment Criterion
0						33%	58%
1	100					29%	58%
2	100	50				29%	58%
3	100	100				29%	58%
4	100	100	100	100		0%	0%
5	100	100			50	14%	58%
6	100	100			75	3%	58%
7	100	100	95	95		1%	52%
8	100	100	80	80		13%	58%
9	100	100	85	85		11%	58%
10	100	100	90	90		2%	55%
11	100	50	50	50		22%	58%
12	100	75	75	75		15%	58%
13	100	100	99.2	99.2		0%	9%

# Draft Pimmit Run TMDL Allocation



Landuse/Source	Annual Average E. coli Loads (cfu/yr)		Reduction (%)
	Existing	Allocation	
Forest	2.70E+12	2.70E+12	0.0
Cropland	8.09E+08	6.47E+06	99.2
Pasture	9.88E+08	7.90E+06	99.2
Urban	2.05E+14	1.64E+12	99.2
Cattle Direct Deposition	0.0	0.0	100.0
Wildlife Direct Deposition	3.10E+12	3.10E+12	0.0
Failing Septics	5.30E+11	0.00E+00	100.0
VPDES Point Sources*	0.0	7.44E+10*	0.0

*\*Draft allocation for VPDES Point Sources includes an allowance for the future growth and expansion of point sources in the watershed.*

# MS4 Allocations

- For this project, to be defined as an MS4 area the following criteria must be met:
  - Within the Geographical Bounds of the Permit Area (for example, if the permit is for Fairfax County, must be within the bounds of Fairfax County)
  - Located within the Census defined Urban Areas (last Census update – 2008)
  - Have land use defined as High, Medium, or Low Density Developed Area.
- The assumption is that the areas that fit the above criteria are roughly equivalent to the areas that drain to MS4 outfalls.
- Best approach at this time to estimate what areas drain to MS4 outfalls. If, in the future, permittees can provide better information regarding their system outfalls and drainage areas, report can be updated at a later date.

# MS4 Allocations

Permit Number	MS4 Permit	MS4 Geographical Area	Developed Acreage	Annual Average Urban Load (cfu/year)	Unit Load (cfu/acre/year)	Wasteload Allocation (cfu/year)	Wasteload Allocation (cfu/day)
Sugarland Run (A10R-01-BAC)							
VA0088587	Fairfax County	Fairfax County	3,711.63	3.67E+12	4.18E+08	1.55E+12	4.25E+09
VAR040104	Fairfax County Public Schools						
VAR040115	Virginia Department of Transportation						
VAR040067	Loudoun County	Loudoun County	3,365.98			1.41E+12	3.86E+09
VAR040115	Virginia Department of Transportation						
VAR040060	Town of Herndon	Town of Herndon	1,695.82				
VAR040104	Fairfax County Public Schools						
VAR040115	Virginia Department of Transportation						
Total MS4			8,773.42			3.67E+12	1.01E+10

Permit Number	MS4 Permit	MS4 Geographical Area	Developed Acreage	Annual Average Urban Load (cfu/year)	Unit Load (cfu/acre/year)	Wasteload Allocation (cfu/year)	Wasteload Allocation (cfu/day)
Mine Run (A11R-02-BAC)							
VA0088587	Fairfax County	Fairfax County	92.47	2.41E+11	2.61E+09	2.41E+11	6.60E+08
VAR040104	Fairfax County Public Schools						
VAR040111	George Washington Memorial Parkway						
VAR040115	Virginia Department of Transportation						
Total MS4			92.47			2.41E+11	6.60E+08

# MS4 Allocations (continued)

Permit Number	MS4 Permit	MS4 Geographical Area	Developed Acreage	Annual Average Urban Load (cfu/year)	Unit Load (cfu/acre/year)	Wasteload Allocation (cfu/year)	Wasteload Allocation (cfu/day)
Pimmit Run (A12R-02-BAC)							
VA0088587	Fairfax County	Fairfax County	3,219.36	1.64E+12	4.03E+08	1.30E+12	3.55E+09
VAR040104	Fairfax County Public Schools						
VAR040111	George Washington Memorial Parkway						
VAR040115	Virginia Department of Transportation						
VAR040067	Arlington County	Arlington County	853.94	1.64E+12	4.03E+08	3.44E+11	9.42E+08
VAR040115	Virginia Department of Transportation						
VAR040111	George Washington Memorial Parkway						
Total MS4			4,073.29			1.64E+12	4.49E+09

# DRAFT TMDLs Expression

Watershed	Point Sources (WLA) cfu/year	Non-point sources (LA) cfu/year	Margin of safety (MOS) cfu/year	TMDL cfu/year
Sugarland Run	3.76E+12	4.99E+12	IMPLICIT	8.75E+12
Mine Run	2.62E+11	1.82E+12	IMPLICIT	2.08E+12
Pimmit Run	1.71E+12	5.73E+12	IMPLICIT	7.44E+12
*1% of the total TMDL is set aside for future growth of VPDES point sources and is added to the WLA				

# Next Steps:

- ◉ Comment Period for Materials Presented at the TAC Meeting extends from November 16, 2011 to December 16, 2011.
- ◉ Comments should be submitted in writing to:  
Katie Conaway  
[Katie.Conaway@deq.virginia.gov](mailto:Katie.Conaway@deq.virginia.gov)  
13901 Crown Court, Woodbridge, VA 22193
- ◉ Final Public Meeting and Release of Draft Report:  
Wednesday, December 14, 2011  
7:00 p.m.  
Great Falls Library Meeting Room  
9830 Georgetown Pike, Great Falls, Virginia 22066

Questions?

# C O N T A C T S

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**Northern Regional Office**

**TMDLs and Water Quality Assessments**

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**Bryant Thomas**

**Virginia Department of Environmental Quality**

**Northern Regional Office**

**Water Quality Permitting, TMDLs and Assessments**

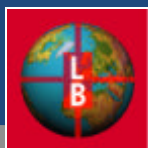
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